

N65928.AR.001560  
NTC ORLANDO  
5090.3a

BIOBARRIER INJECTION PILOT STUDY WORK PLAN FOR OPERABLE UNIT 2 (OU 2)  
TECHNICAL MEMORANDUM NTC ORLANDO FL  
1/12/2006  
AGVIQ-CH2MHILL

# **Biobarrier Injection Pilot Study Work Plan**

## **Operable Unit 2, Naval Training Center Orlando, Florida**

PREPARED FOR: Barbara Nwokike – Southern Division, NAVFAC

PREPARED BY: CH2M HILL Project Team

COPIES: Mike Singletary, NAVFAC  
Steve Tsangaris, CH2M HILL  
Isaac Lynch, CH2M HILL  
Paul Favara, CH2M HILL

CONTRACT: Response Action Contract No. N62467-03-D-0260

CTO: CTO 002, Naval Training Center Orlando

DATE: January 12, 2006

## **1. Introduction**

The Navy has contracted the AGVIQ/CH2M HILL Joint Venture II (JV-II) to implement the groundwater remedial action (RA) at Operable Unit 2 (OU-2) at the Former Naval Training Center (NTC) McCoy Annex in Orlando, Florida. A permeable bioreactive barrier (biobarrier) was selected as the RA preferred alternative to intercept the portion of the southern groundwater chlorinated volatile organic compound (CVOC) plume that is entering the Greater Orlando Airport Authority (GOAA) property.

This technical memorandum (TM) is organized into the following sections:

- Site History and Background
- Project Organization and Schedule
- Scope of Work
- Data Analysis Methods

## **Biobarrier Configuration**

In general, biobarrier design includes selection of the location, substrate (for example, soluble or slow-release), and substrate delivery method (for example, direct push technology [DPT], permanent injection wells, or extraction-injection recirculation). The proposed OU-2 biobarrier will be formed at the OU-2-GOAA property line using a slow-release carbon source (that is, Emulsified Oil Substrate [EOS®]) injected in permanent injection/ monitoring wells. The proposed biobarrier is based on the following preliminary design considerations:

- Because the proposed biobarrier location is nearly 1 mile from utilities, a passive barrier approach is expected to be more cost-effective than active extraction and injection.
- The targeted saturated zone is a relatively homogeneous, conductive, and sandy aquifer that is anticipated to allow a uniform distribution of substrate using injection alone.

- Use of EOS® rather than a soluble substrate (such as sodium lactate) will significantly minimize the number of re-injection events during the required life of the biobarrier.
- Injection wells, rather than DPT point, are the preferred substrate delivery option. The injection wells can be manifolded together so that high injection volumes can be achieved to minimize injection costs.

## Pilot Study Purpose

One of the most critical biobarrier design elements is the prediction and control of injected fluid movement through aquifer materials. This *Biobarrier Injection Pilot Study Work Plan* describes the field work for collecting the following critical design elements:

- Sustainable injection flow rate of substrate into two injection wells installed along the proposed biobarrier alignment.
- Vertical and horizontal variability of substrate injection into the shallow aquifer.
- Achievable radius of injection (ROI) using field data that include groundwater levels, water quality, organic carbon concentration, and bromide<sup>1</sup> concentrations in surrounding monitor wells.
- Substrate concentrations in the injected solution to achieve target organic carbon concentration throughout the reactive zone.
- Injection volume per injection location required to achieve overlap and form complete biobarrier.
- Optimal well screen configuration.

## 2. Site History and Background

OU-2 is located in the southern portion of the McCoy Annex landfill at NTC Orlando (Figure 1). OU-2 consists of approximately 114 acres and includes a former landfill that was operated by the U.S. Air Force and Navy from 1960 to 1978; a nine-hole golf course now occupies a portion of the site.

### Site Environmental History

The OU-2 area was previously investigated by Tetra Tech NUS, Inc. between 1997 and 2001 during a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI). Several phases of groundwater DPT sampling were conducted with the objective of defining the nature and extent of contaminated groundwater. Other previous studies include an Initial Assessment Study by C.C. Johnson in 1985 and a Verification Study conducted by Geraghty & Miller in 1986.

---

<sup>1</sup> Conservative tracer injected with the substrate solution as sodium bromide.

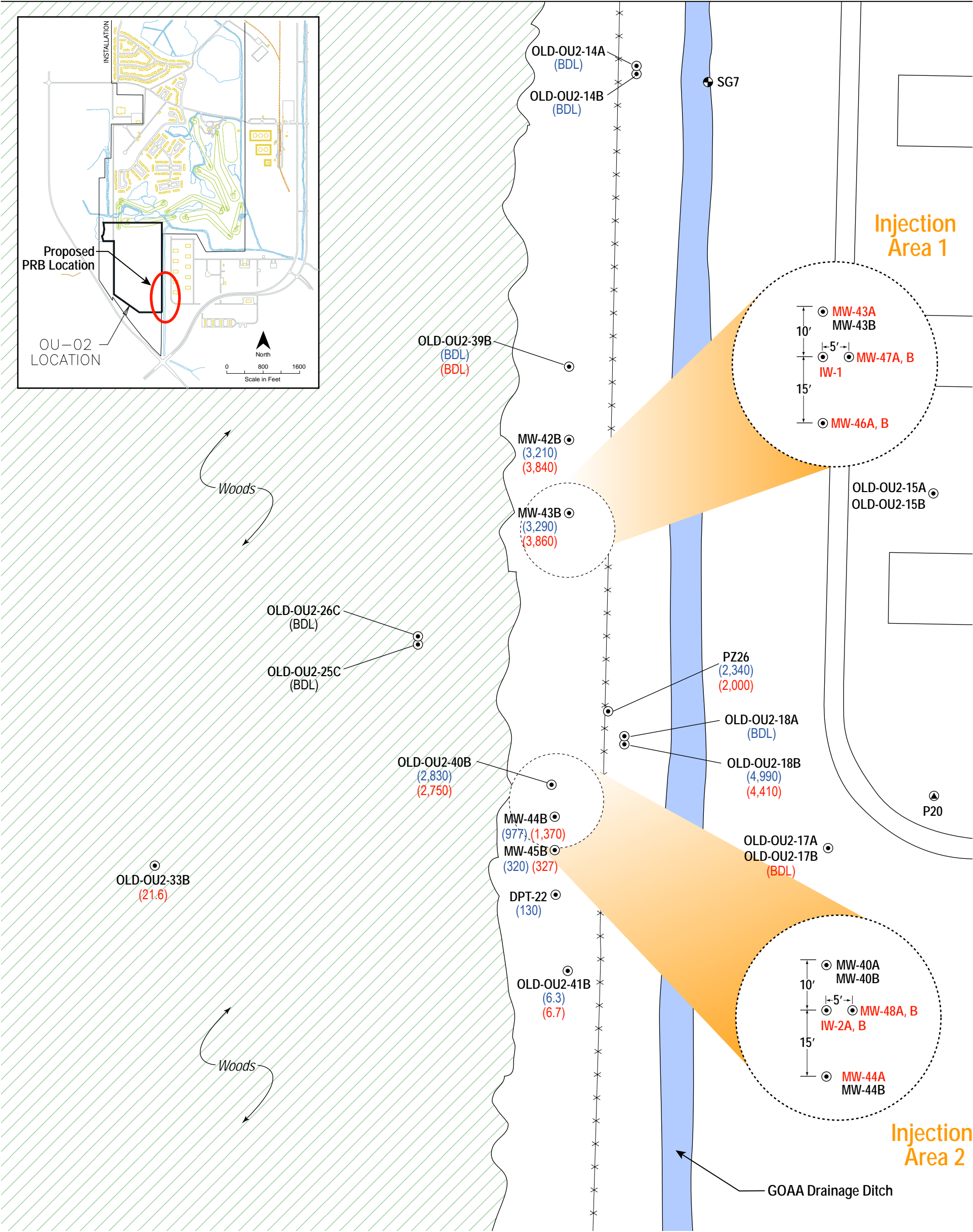


FIGURE 1  
Injection Test Locations and TCE Concentrations  
OU2, Orlando Naval Training Center  
Orlando, Florida

U.S. Naval Facilities Engineering Command, Engineering Field Division, Southern Division (NAVFAC EFD SOUTH) identified dissolved CVOCs (primarily trichloroethylene [TCE]) in two shallow groundwater plumes that are migrating toward drainage canals running along the eastern perimeter of the site. The drainage canals are partially located on property now owned by the GOAA.

## Additional Site Investigation

Beginning in June 2004, a phased-investigation was conducted to further delineate the southern TCE plume and collect site-specific hydrogeologic data. During the first investigation phase, 25 DPT borings were installed along the eastern landfill property boundary to horizontally and vertically delineate the CVOC plume. During Phase II, another nine DPT borings were installed between the east fence line and the west bank of the GOAA ditch to further evaluate the potential impact to the offsite surface water due to plume migration. Finally, a series of temporary well points were installed in the GOAA ditch and sampled to further evaluate potential impacted groundwater discharge to surface water. Sediment samples were also collected from the well point locations. The findings from the June 2004 investigation were used to guide the installation of permanent monitor wells along the potential zero valent iron (ZVI) PRB alignment, which was the planned alternative for the site before the biobarrier was selected<sup>2</sup>. The monitor wells and several additional DPT borings were installed and sampled in late 2004 and April 2005. Groundwater was collected in late 2004 for the column study that was conducted in early 2005; results are discussed below.

PCE and its degradation components (TCE, *cis*-1,2-DCE, and vinyl chloride [VC]) have been detected at DPT and permanent monitor well locations, as well as in soil and groundwater samples collected from the GOAA ditch bottom. The most predominant compound, TCE, has been detected at a concentration up to 6,800 micrograms per liter (µg/L) in groundwater grab samples collected from the offsite direct push technology (DPT) locations and 4,410 µg/L in permanent monitor well (MW)-18B. PCE, *cis*-1,2-DCE, and VC have been detected at concentrations up to 113, 224, and 82 µg/L, respectively, during the pre-design investigations.

## Site Geology

Site geology consists of relatively flat surface topography on unconsolidated, Quaternary, and undifferentiated fine grained sands and silty sands from the ground surface to depths of approximately 35 to 40 feet. The sands are underlain by a sequence of clays, sandy-clay mixtures, and sand units comprising the Hawthorn Group, which is of Miocene-Pliocene age. The uppermost unit of the Hawthorn Group present at the site is olive-green phosphatic clay of low permeability. This clay is 10 to 20 feet thick at the proposed biobarrier alignment, and serves as an aquitard for the unconfined (water table) shallow aquifer system. A secondary confined aquifer exists within a sand unit which lies directly below the Hawthorn clay layer.

---

<sup>2</sup> A ZVI PRB was initially considered to minimize contaminant transport across the property boundary. After additional field testing and pre-design analysis, the ZVI PRB was replaced with a biobarrier. Much of the field data collected to support the design of the ZVI PRB will be used to design the biobarrier.

## Site Hydrogeology

The potentiometric surface of the unconfined (water table) aquifer typically occurs at depths of about 6 to 8 feet below land surface (bls). The hydraulic conductivity of the unconfined aquifer was reported to range from 4 to 25 feet/day. The hydraulic gradients are low (~0.002 feet/foot), with groundwater movement generally to the east at velocities less than 100 feet per year. The bottom of the GOAA ditch is below the average groundwater table elevation in the area. As such, the ditch does receive base flow all year.

Water level data from well pairs installed in the shallow and deep zones of the surficial aquifer indicate that they behave as one hydrologic unit with respect to groundwater movement and contaminant distribution. Shallow (A zone wells) and deep (B zone wells) groundwater levels around the GOAA ditch indicate vertical gradients that are temporally and spatially variable. The piezometer pairs between the property line and the GOAA ditch indicate a slight upward gradient, suggesting that the GOAA ditch does serve as a hydraulic barrier. However, MW-18A/B, which is in the same area as the piezometers, indicates a relatively strong downward gradient. The vertical gradient of the underlying Hawthorn clay aquitard is reported to be upward.

The ditch well points installed during Phase II of the Pre-Design Collection Activities<sup>3</sup> also indicate a variable vertical gradient. During months with low average precipitation rates (January and March), the ditch is gaining and as a result, the vertical gradient is generally upward. In comparison, during July and August, when rainfall rates are higher, surface water runoff volumes and groundwater recharge rates are increased, the stream is losing and the vertical gradients are downward. On the east side of the ditch, the vertical gradients tend to be downward likely due to routine irrigation around MW-17A/B.

## 3. Regulatory Considerations

No permits are required prior to installation of the monitor wells. For the injection wells, applicable Underground Injection Control (UIC) regulations are listed at Rule 62-528, Florida Administrative Code (FAC) (Underground Injection Control); specifically, Part V – Criteria and Standards for Class V Wells and Part VI – Class V Well Permitting.

In a letter dated May 20, 2005 from Mr. Rick Ruscito, P.E. and Rebecca Lockenbach of the Bureau of Petroleum Storage Systems, Florida Department of Environmental Protection (FDEP), to Mr. Gary Birk of EOS® Remediation, Inc., the agency and regulatory requirements for performing EOS® injections at remediation sites were outlined (Attachment A). The letter states that “the issuance of a site-specific remedial action plan approval order by the FDEP, for remediation via injection of EOS® into an aquifer, constitutes the granting of the state’s permit for a Class V Injection Well.”

In addition, for FDEP acceptance of the use of EOS® as a product for in situ anaerobic bioremediation and the allowance of a zone of discharge (ZOD) by Rule 62-522.300(2)(c) FAC, the following conditions need to be addressed in the full-scale Remedial Action Work Plan (RAWP), which has to be accepted by FDEP prior to RA implementation:

<sup>3</sup> *Technical Memorandum: Summary of Pre-Design Data Collection Activities, Remedial Action at Operable Unit 2, Former NTC Orlando (CH2M HILL, 2004)*

1. Identification of the chemical species contained in EOS® that will be introduced into the subsurface via the injection well, namely Polysorbate 80, total recoverable petroleum hydrocarbon (TRPH), sodium, total dissolved solids, chloride (if significant amounts of this degradation byproduct will be generated) and bromide (tracer).
2. Indication of the size and duration of the temporary ZOD of EOS®. For this pilot study at OU-2, the ZOD will comprise two areas totaling 1,500 ft² (estimated ROI of 15 feet) extending from approximately 20 to 40 feet bgs. The actual duration of the EOS® discharge into the aquifer is expected to be approximately 5 days.
3. Addresses groundwater monitoring of Polysorbate 80, TRPH, sodium, bromide, and total dissolved solids (TDS) before and after injection; chlorides will not be monitored because the objectives of this pilot study do not include monitoring of reductive dechlorination. The ZOD will be monitored prior to introduction of EOS® into the aquifer as part of a baseline sampling and analysis event and again after injection is complete.

Additionally, this letter stipulates that the injection of EOS® will be performed in such a manner that prevents the undesirable migration of either the product's ingredients or the contaminants already in the aquifer. The groundwater and injection flow rate at OU-2 is not expected to cause migration of either EOS® or CVOCs already present in the area. Furthermore, because the GOAA ditch is nearly 75 feet downgradient of the injection wells, surface water quality degradation due to the injection of the carbon substrate is not expected during the pilot study.

## 4. Project Organization

The NAVFAC EDF SOUTH is the lead agency for this project. The Southern Division Remedial Project Manager (RPM), Barbara Nwokike, is responsible for the overall environmental activities at NTC Orlando.

### Communications

Communications with the client and subcontractors will be through Steve Tsangaris. The project team includes the following personnel:

- **Project Manager**  
Steve Tsangaris/TPA [813-874-6522, x4305]
- **Project Design/Coordination**  
Mike Perlmutter/ATL [770-604-9182, x645]  
Paul Favara/GNV [352-335-7991 x2396]
- **Field Team**  
Isaac Lynch/GNV [cell: 352-494-3822]

The subcontractors will include the following drilling and substrate/injection subcontractors.

- **Drilling Subcontractor**  
To Be Determined

- **Substrate/Injection Subcontractor**  
Solutions IES

## 5. Project Schedule

The injection test is scheduled to begin in February 2005. Field activities are anticipated to last 3 to 4 weeks.

## 6. Scope of Work

This biobarrier injection pilot study will include the following primary activities:

- Monitor and injection well installation
- Substrate preparation
- Substrate injection
- System monitoring
- Data analysis and reporting

### Monitor and Injection Well Installation

All monitor and injection well locations will be marked or staked in the field prior to initiation of field work, and the necessary agencies and departments will be notified regarding activities planned at these locations. Clearance and marking of existing underground water, natural gas, telephone, electrical and other utility lines which are potential hazards at the site will be obtained prior to mobilization. Once utilities are marked and identified, sample locations will be adjusted as needed.

Hollow-stem augers will be used to advance 8-inch diameter boreholes to the total drilling depths at each proposed well location. Split-spoon samples will be collected during installation of the deep monitor wells. Continuous sampling will begin at 20 feet bls and continue to the top of the Hawthorn clay, at an approximate depth of 35 to 40 feet bls. A written soil boring log will be generated for each boring that will describe and record the physical appearance of the recovered samples. The description includes Unified Soil Classification System (USCS) soil classification with a visual assessment of grain size, color, consistency, and moisture content. Sample depth, percent recovery, and photoionization detector (PID) readings will be recorded. Soil samples will be analyzed in an offsite laboratory for grain size analysis and pre-injection total organic carbon (TOC) concentrations.

Eight new monitor wells and three new injection wells will be installed as shown on Figure 1; proposed depths and screened intervals are summarized in Table 1. The new monitor wells, along with four existing monitor wells (MW-40A, -40B, 43B, and -44B), will be used to achieve the pilot study objectives. As indicated on Figure 1, one injection well with a 20-foot long screen will be installed in Injection Area 1 (IW-1); two nested injection wells with 10-foot long screens will be installed in Injection Area 2 (IW-2A and -2B).

**TABLE 1**  
Existing and Proposed Monitor and Injection Well Summary  
*Biobarrier Injection Pilot Study, NTC Orlando*

Well	Purpose	Approximate Depth (ft bls)	Screen Interval (ft bls)	Distance from IW (ft)
Injection Area 1 (depth to clay = 35 feet)				
Proposed IW-1	New injection well to evaluate effectiveness of substrate delivery via one fully-screened interval.	35	15-35	—
Proposed MW-43A	New shallow monitor well installed 10 feet from IW-1 to evaluate ROI.	25	20-25	10
MW-43B	Existing deep monitor well 10 feet from IW-1 to evaluate ROI.	35	30-35	10
Proposed MW-46A	New shallow and deep monitor well pair installed 15 feet from IW-1 to evaluate ROI.	25	20-25	15
Proposed MW-46B		35	30-35	15
Proposed MW-47A	New shallow and deep monitor well pair installed 5 feet from IW-1 to evaluate ROI.	25	20-25	5
Proposed MW-47B		35	30-35	5
Injection Area 2 (depth to clay = 35 feet)				
Proposed IW-2A	New injection wells to evaluate effectiveness of substrate delivery via two nested screened interval.	30	20-30	—
Proposed IW-2B		40	30-40	—
MW-40A	Existing shallow monitor well installed 10 feet from IW-2 to evaluate ROI.	25	20-25	10
MW-40B	Existing deep monitor well 10 feet from IW-2 to evaluate ROI.	44	39-44	10
Proposed MW-44A	New shallow monitor well installed 15 feet from IW-2 to evaluate ROI.	25	20-25	15
MW-44B	Existing deep monitor well 15 feet from IW-2 to evaluate ROI.	35	30-35	15
Proposed MW-48A	New shallow and deep monitor well pair installed 5 feet from IW-2 to evaluate ROI.	25	20-25	5
Proposed MW-48B		35	30-35	5

**Note:** Existing wells are shaded.

## Monitoring Well Construction

Each monitoring well will be constructed of 2-inch inside diameter flush-threaded, Schedule 40 PVC solid riser and 0.010-inch factory-slotted well screen with a silt trap style threaded well bottom cap.

Five A zone monitoring wells with 5-feet long screens will be terminated at approximately 25 feet bls. Three B zone interval monitoring wells, installed with 5-feet long screens, will be terminated at an approximate depth of 35 feet bls. Exact depth of B zone wells will be determined based upon results of split spoon sampling to determine the depth of the Hawthorn clay.

All well casings will be new, unused, decontaminated Schedule 40 PVC pipe with internal flush joined threaded joints that conform to the American Society for Testing and Materials (ASTM) Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe

System). Well screens will be made from new, unused, and decontaminated PVC pipe with internal flush joined threaded joints. A threaded PVC cap or well point will be placed at the bottom of the screen. Each well will be constructed with a threaded well top cap.

### **Injection Well Construction**

All injection well casings will be 2-inch diameter, Schedule 40 PVC. Injection well screens will be constructed of a continuous slot, wire-wound design to provide maximum inlet area consistent with strength requirements. The well screen will be manufactured by Johnson Screens (PVC Vee-Wire) or approved equivalent technology. The Johnson PVC Vee-Wire well screen (or approved equal) will be 2-inch diameter with 0.020-inch openings. All complementary fittings will be Schedule 40 PVC.

One injection well will be constructed with a 20-foot well screen, and will be terminated at a depth of approximately 35 feet bls, with actual total depth directly above the top of the Hawthorn clay layer, based upon results of split spoon sampling.

The other two injection wells will be installed as a well pair. One well will be installed to approximately 35 feet bls based on split spoon results, and the other well will be installed to a depth 10 feet shallower, at approximately 25 feet bls. Both wells will be constructed with a 10-foot well screen, with screens positioned so that the pair covers a continuous 20-foot vertical thickness of the surficial aquifer to the top of the Hawthorn clay.

### **Filter Pack**

The filter pack material will consist of inert, washed, well rounded 20/30 mesh silica sand (less than 2 percent flat particles), and free from roots, trash, and other deleterious material. The sand will be certified free of metals and VOCs by vendor. The filter pack will extend from the bottom of the borehole to at least 2 feet above the top of the well screen.

The filter pack will be installed with a bottom-discharge tremie pipe. The tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. The filter pack will be tagged continuously during this process to ensure proper placement. Potable water may be used to emplace the filter pack so long as no contaminants are introduced. During drilling of unconsolidated materials or clays which will not stay open without the hollow-stem augers in place, the filter pack will be placed after the well casing is set to the correct depth and as the augers are being withdrawn.

### **Bentonite Seal**

A granular bentonite seal at least 2 feet thick will be emplaced immediately above the top of the filter pack in each well. The 100 percent sodium bentonite seal will consist of 1/4-inch or 3/8-inch diameter dry pellets or chips. The bentonite seal may be installed by gravity or tremie methods to prevent bridging in the annular space. If the seal is placed above the water table, then sufficient water will be added to the bentonite to allow complete hydration of the bentonite. The bentonite seal will be allowed to hydrate for a minimum of 4 hours prior to the installation of the cement grout.

## **Cement Grouting**

Cement grout will be placed in the annular space above the bentonite seal to ground surface. The grout will be pumped through a side-discharge tremie pipe with the length will be no more than 5 feet from the top of the level of grout at all times. The pumping will continue until grout has returned to the surface. The grout seal will be made using ASTM C150 Type II Portland cement with no more than 4 percent bentonite. The grout will be allowed to cure for a minimum of 8 hours after placement before further grouting or other work is done in the well.

## **Surface Completion**

Wells will be set as flush-mounted to ground completions. The casing will be cut approximately 12 inches bls and a PVC coupling and a watertight well cap will be installed on the monitoring wells. Each injection well riser pipe will be terminated with a 2-inch standard male Camlock fitting and cap. The Camlock fitting will be attached to the well riser via a threaded adapter/collar, so that it may be removed if necessary.

A freely draining 8-inch inner diameter steel water valve vault with cover with a locking lid will be placed over the injection and monitoring well locations. The vault will be approximately 18 to 24 inches deep. The top of the well casings will be at least 12 inches above the bottom of the vault. The vault will be centered in a 2-foot diameter, 4-inch thick concrete pad that slopes away from the vault at 1/4-inch per foot. The identity of the well will be permanently marked on the concrete pad.

Wells will be secured as soon as possible after drilling with corrosion resistant locks supplied by the subcontractor. The locks must either have identical keys or be keyed for opening with one master key.

## **Well Development**

Well development will be initiated no sooner than 24 hours following grout installation. Although no air, detergents, soaps, acids, bleaches, airlifting, or additives will be used during well development, polyphosphates and other chemicals may be required to completely develop the injection wells. Well development will continue until clear, sand-free formation water is produced from the wells and the required injection capacity is achieved. Water from development will be contained and disposed in accordance with waste management procedures described in this scope of work.

## **Decontamination**

Decontamination of the drill rig, augers, pipes, bits, tools, and all downhole equipment will consist of high pressure, low volume steam-cleaning at the temporary drilling equipment decontamination pad. All tools and drilling equipment to be placed in the drill hole and the rear of the drill rig will be steam-cleaned before drilling begins, between each boring, and after work is completed. All personnel protection clothing and articles will be contained in drums and disposed of separately.

## **Substrate Preparation**

Assuming a maximum ROI of 15 feet, a total screen length of 20 feet, and an effective porosity of 20 percent, approximately 21,000 gallons could be injected per location.

However, if vertical migration throughout the entire 30-foot thick saturated zone is considered, nearly 30,000 gallons could be injected per location.

Typically, only 10 to 50 percent of the pore space is actually available for injected fluid migration<sup>4</sup>. As a result, only 2,000 to 10,000 gallons of injected fluid will likely be required to achieve an effective ROI of 15 feet.

Based on electron acceptor flux and reapplication frequency (every 2 years), a 1 percent EOS® solution will be required to develop the biobarrier at OU-2. For 10,000 gallons of injection fluid per injection area, 100 gallons or about two drums of EOS® will be required; four drums will be required to test both injection well configurations. Water will be supplied from an existing fire hydrant located approximately 0.7 miles from the biobarrier alignment. The hydrant will be plumbed to an onsite fractionation (frac) tank, which will serve as the reservoir for the injection study.

Substrate preparation/injection can be conducted in two ways:

1. Transfer 1 gallon of EOS® concentrate per 100 gallons of unamended water directly to the frac tank. Pump the blended substrate solution from the frac tank to the injection well(s).
2. Pump unamended water from the frac tank through a passive metering system (for example, Dosatron), which pulls EOS® concentrate directly from the drums into the water line. The water pressure forces the diluted emulsion downstream to the injection well. The amount of EOS® concentrate is directly proportional to the volume of water entering the system so variations in water pressure or flow rate have no effect on the dilution.

In addition to the substrate, a tracer will be injected that will allow for monitoring of the movement of groundwater away from each of the injection wells. Sodium bromide, a salt with high solubility in water, will be used as the tracer at an approximate concentration of 200 milligrams per liter (mg/L). About 15 pounds of sodium bromide and 20 pounds of sodium bicarbonate will be added to each 10,000 gallons of injection fluid to improve the buffering capacity of the aquifer.

## Substrate Injection

The substrate solution will be injected into the shallow aquifer via the 2-inch-diameter injection wells. The fluids will be pumped by a Watson Marlow SPX-40 high-pressure hose pump (or similar apparatus) capable of producing 20 gallons per minute (gpm). Pressure gauges connected to the injection pipeline will allow observers at the surface to note the amount of resistance to the fluid being pumped into the aquifer. Injection pressure is expected to be less than 50 pounds per square inch (psi). In Area 2, the substrate solution will be injected into IW-2A and -2B concurrently.

After baseline water levels are measured in all surrounding wells, flow of water will be initiated to the well. Extreme care will be used to slowly introduce flow to the wellhead and avoid formation air lock. By leaving the air-bleed valve on the wellhead open during well filling, air will be allowed to vent from the well. Once the injection well is completely full of water, the air-bleed valve will be closed, allowing the injection well to slowly pressurize. Groundwater levels will be frequently monitored (every 15 to 30 minutes) during the start

<sup>4</sup> Suthersan, S.S and F. C. Payne. 2005. *In Situ Remediation Engineering*. CRC Press.

of injection so that groundwater surface flooding can be avoided. Pressure transducers and data loggers will be installed in all six surrounding monitor wells. The injection pressure will be increased until the water level in the nearest monitor well reaches and remains at approximately 2 feet bgs. The flow rate at this steady-state condition will be considered to be the sustainable injection flow rate for that particular well. This procedure will be repeated for each of the two injection areas.

Pumping duration will be a function of the real-time monitoring results, as discussed in the following section. It is anticipated that 10,000 gallons of injection fluid may be inserted at each injection area; the injection wells in Area 2 will receive about 5,000 gallons each. At the targeted flow rate of 10 gpm, the entire injection event will last approximately 30 hours.

## System Monitoring

Performance monitoring will be conducted during three intervals of the pilot study: 1) pre-injection, 2) during active injection, and 3) 30 days after completion of injection.

### Pre-Injection

In addition to the three new injection and eight new monitor wells, baseline groundwater samples will be collected from the four existing monitor wells and analyzed in the field for alkalinity (field kit), pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), TOC (field kit), conductivity, and turbidity.

Samples will also be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area to assess baseline CVOs, phospholipids fatty acids (PLFA) and volatile fatty acid (VFA) concentrations, and the microbial population (Polymerase Chain Reaction [PCR] analysis). Also, to satisfy the requirements of the ZOD rule, samples will be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area and analyzed for Polysorbate 80, TRPH, sodium, bromide, and TDS. The drinking water analysis method SM5540D for foaming agents has been identified as the preferred method of laboratory analysis for Polysorbate 80.

Sampling parameter rationale is summarized in Table 2. Samples will be collected with a peristaltic pump (Geopump).

### During Active Injection

During the course of injection at each injection area, water samples from downgradient wells will be monitored to check for substrate breakthrough and assess the surrounding potentiometric surface. Water levels will be measured and samples will be collected from the six surrounding monitoring locations after every 2,000 gallons have been injected, about two or three times per day. The groundwater samples will be analyzed in the field for alkalinity (field kit), pH, ORP, DO, TOC (field kit), conductivity, and turbidity. In addition, samples will be collected for bromide analysis and to visually assess the presence of the milky white substrate solution.

The injection system will also be monitored regularly for injection flow rate and pressure to determine whether they need to be adjusted during the injection process.

**TABLE 2**  
List of Groundwater Sampling Analytes and Monitoring Parameters  
*Biobarrier Injection Pilot Study, NTC Orlando*

Parameter	Method	Reason for Monitoring	System Monitoring		
			Pre-Injection	During	Post-Injection
Field Tests					
Injection flow rate and pressure	Flow meter and pressure gauges	Evaluate design parameters for full-scale design.	—	Routinely.	—
Water level	Water level meter	Provides quantitative indication that injection fluids are reaching the monitor well. Minimize potential for ground surface flooding.	3 IWs; 8 new MWs; 4 existing MWs	8 new MWs; 4 existing MWs (after every 2,000 gallons injected)	3 IWs; 8 new MWs; 4 existing MWs
ORP	Multi-parameter meter	Used in conjunction with other geochemical parameters, ORP indicates which terminal electron accepting processes predominate in an anaerobic environment and whether groundwater conditions are optimal for anaerobic biodegradation.			
Specific conductivity		General water quality parameter used as a well purging stabilization indicator. May correlate with and support interpretations of other geochemical analyses.			
Turbidity					
pH					
EOS	Visual	A direct measurement indicating substrate is reaching the monitor well.	—		
DO	Field test kit Hach Product #: 146900	DO should be depleted in an anaerobic bioremediation system. DO less than 0.5 mg/L generally indicates an anaerobic pathway suitable for anaerobic dechlorination to occur.	3 IWs; 8 new MWs; 4 existing MWs		
Alkalinity	Field test kit Hach Product #: 2444301	Indicator of biodegradation and the buffering capacity of the aquifer. Used in conjunction with pH, an increase in alkalinity and stable pH indicates the buffering capacity of the aquifer is sufficient to neutralize metabolic acids produced by degradation of substrates.			

**TABLE 2**  
List of Groundwater Sampling Analytes and Monitoring Parameters  
*Biobarrier Injection Pilot Study, NTC Orlando*

Parameter	Method	Reason for Monitoring	System Monitoring		
			Pre-Injection	During	Post-Injection
TOC	Field test kit Hach Product #: 2815945	Indicator of natural organic carbon present at site during baseline characterization and as an indicator of substrate distribution during performance monitoring. Commonly, TOC concentrations ranging from 50 to 100 mg/L are required to foster reductive dechlorination.	3 IWs: 8 new MWs; 4 existing MWs	8 new MWs; 4 existing MWs (after every 2,000 gallons injected)	3 IWs; 8 new MWs; 4 existing MWs
Lab Tests					
CVOC	Method 8260	Measure baseline and post-injection CVOC concentrations to assess influence from injection (e.g., displacement)	MW-40A/B MW-43A/B	—	MW-40A/B MW-43A/B
PLFA	GC/MS	Assess microbial consortia based on biomass viability, community structure, and metabolic activity.		—	
VFAs	Ion chromatography	Pyruvate, lactate, formate, acetate, propionate, and butyrate are used as biomarkers of anaerobic metabolism. Anaerobic bacteria produce these compounds by fermentation, while under aerobic conditions these compounds are rapidly oxidized for carbon and energy by aerobic bacteria.		—	
qPCR	Lab-specific	qPCR — a DNA-based approach — provides direct information about the dominant biological processes occurring within the subsurface		—	
Polysorbate 80	SM 5540D	FDEP ZOD rule (recommended lab: Weck Laboratories)		—	
TRPH	Method 418.1	FDEP ZOD rule		—	
Sodium	Method 6010B			—	
TDS	Method 160.1			—	
Bromide	E320.1	A direct measurement indicating substrate is reaching the monitor well.		8 new MWs; 4 existing MWs (after every 2,000 gallons injected)	
TOC (soil)	SW9060	Assess the distribution of TOC and/or oil emulsion within the aquifer matrix	MW-47B MW-48B	—	4 DPT samples

## Post-Injection

Thirty days after the completion of the injection test, an additional set of groundwater samples will be collected from the 12 monitor and 3 injection wells in the two test areas. The groundwater samples will be analyzed in the field for alkalinity (field kit), pH, ORP, DO, TOC (field kit), conductivity, and turbidity. The presence of the milky white substrate solution will also be assessed visually.

Again, to satisfy the requirements of the ZOD rule, samples will be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area and analyzed for Polysorbate 80, TRPH, sodium, bromide, and TDS. Samples will also be collected from the same wells for CVOC and VFA analysis. Although it may be too soon to see much reductive dechlorination occurring after 1 month, the CVOC data can be used to assess contaminant displacement due to substrate injection.

Finally, soil samples will be collected from select horizontal and vertical locations in the two test areas and analyzed for TOC at an offsite laboratory. These results will be compared to pre-injection results to assess the distribution of the oil emulsion within the aquifer matrix.

## Data Analysis and Reporting

Laboratories performing the analyses will meet the qualifications and certifications as per the Navy's *Installation Restoration Program Chemical Data Quality Manual (IR CDQM) FESC SP-2056-ENV, September 1999* (Naval Facilities Engineering Service Center [NFESC]). Laboratories will have undergone the laboratory approval process as defined in the subject NFESC document for the scope of work performed under the IRP. The Navy-approved laboratory will also have certification from the State of Florida through the National Environmental Laboratory Accreditation Program (NELAP), which will be used for all sample analyses.

Data collected at each injection and monitoring location will be compiled to provide an overview of the changes that occurred throughout the injections. All data and resulting interpretation will be presented and described within a TM. Specifically, the data, which will be used as a basis for the design for the full-scale biobarrier, will be used to estimate the following:

- Sustainable injection flow rate
- Substrate distribution and biobarrier uniformity
- Injection volume and ROI
- Substrate concentration
- Optimal well screen configuration

ATTACHMENT A

# FDEP EOS® May 2005 Acceptance Letter

---



# Department of Environmental Protection

Jeb Bush  
Governor

Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

Colleen M. Castille  
Secretary

May 20, 2005

Gary M. Birk, P.E.  
EOS Remediation Incorporated  
3722 Benson Drive  
Raleigh, North Carolina 27609

Re: **Edible Oil Substrate (EOS)**

Dear Mr. Birk:

The Florida Department of Environmental Protection hereby reaffirms and updates its acceptance of Edible Oil Substrate (EOS), a product for in situ anaerobic bioremediation of chlorinated hydrocarbons and other suitable contaminants in groundwater and soil. EOS is a U.S.-patented product containing soybean oil as the primary substrate, emulsifiers and surfactants.

This letter supersedes the original April 7, 2003 acceptance letter that was issued to EOS Remediation Incorporated in Raleigh, North Carolina, and contains four major revisions. The first is a correction that indicates a temporary injection zone of discharge is permitted by rule, not by variance, for soybean oil (total recoverable petroleum hydrocarbons), and polysorbate 80 (a surfactant). The second considers an analytical method for measuring the concentration of polysorbate 80 in groundwater samples. The third is an indication that lecithin is no longer an ingredient, and the fourth is a clarification that sodium bromide tracer is not one of the manufacturer's ingredients but rather added independently, later, by some but not all users.

Although this acceptance applies only to the regulatory jurisdiction and the remediation needs of this Department, other agencies and local governments may choose to recognize it if their needs are similar. This Department, however, is not responsible for applications beyond its own jurisdiction.

For in situ groundwater remediation, via direct injection of EOS into an aquifer, there are underground injection control regulations that must be observed. Since in situ aquifer remediation via injection is likely to be the most common application of this product, the bulk of the regulatory requirements discussed herein will be directed to it.

The Department recognizes EOS as a viable product for the bioremediation of contaminated sites in Florida. There are no objections to its use provided: (a) the considerations of this letter are taken into account; (b) a site-specific Remedial Action Plan is approved by the Department; (c) the approved Remedial Action Plan complies with Rule 62-522.300(2)(c), Florida Administrative Code (F.A.C.), in order to permit a temporary injection zone of discharge for soybean oil's total recoverable petroleum hydrocarbons (TRPH); polysorbate 80 surfactant; sodium (depending on the amount of sodium lactate); total dissolved solids; and chloride (a contaminant degradation byproduct).

*"More Protection, Less Process"*

Visit Our Internet Site At: [www.dep.state.fl.us/waste/categories/pcp/default.htm](http://www.dep.state.fl.us/waste/categories/pcp/default.htm)

*Printed on recycled paper.*

While the Department of Environmental Protection does not provide endorsement of specific or brand name remediation products or processes, it does recognize the need to determine their acceptability from a regulatory standpoint with respect to applicable rules and regulations, and the interests of public health and safety. Vendors must then market the products and processes on their own merits regarding performance, cost and safety in comparison to competing alternatives in the marketplace. In no way, however, shall this regulatory acceptance be construed as certification of performance. Additionally, the Department emphasizes a distinction between its regulatory "acceptance" and an approval. Products and processes are accepted but they are not approved.

Also, it is not a requirement that a particular remediation product or process have an official acceptance letter in order for it to be proposed in a site-specific Remedial Action Plan. The plan, however, must contain sufficient information about the product or process to show that it meets all applicable and appropriate rules and regulations.

Those who prepare Remedial Action Plans may include a copy of this letter in the appendix of plans they submit, and call attention to it in the text of their document. In this way, technical reviewers throughout the state will be informed that you have contacted the Department of Environmental Protection to inquire about the environmental acceptability of EOS. To aid those reviewers, the Department provides environmental and regulatory information as Enclosure 1. Enclosure 2 contains supplemental information.

The Department reserves the right to revoke its acceptance of a product or process if it has been falsely represented. Additionally, Department acceptance of any product or process does not imply it has been deemed applicable for all cleanup situations, or that it is preferred over other treatment or cleanup techniques in any particular case. A site-specific evaluation of applicability and cost-effectiveness must be considered for any product or process, whether conventional or innovative, and adequate site-specific design details must be provided in a Remedial Action Plan. You may contact Rick Ruscito at (850) 877-1133, extension 29, if there are any questions.

Sincerely,

Rick Ruscito, P.E.  
Ecology and Environment, Inc.  
Bureau of Petroleum Storage Systems  
Petroleum Cleanup Section 6

Rebecca S. Lockenbach  
FDEP Section Leader  
Bureau of Petroleum Storage Systems  
Petroleum Cleanup Section 6

enc: (1) Regulatory Information  
(2) Supplemental Information

c: T. Conrardy - FDEP, Tallahassee/MS 4530

History:

4/7/03  
ppl #214  
inn\_103.doc

5/20/05  
ppl #275  
inn\_103a.doc

ENCLOSURE 1

REGULATORY INFORMATION

- a. Groundwater cleanup standards: The onus shall be on users of EOS to ensure that all applicable groundwater standards will be met at the time of project completion for chlorinated hydrocarbons and any other contaminants of concern, any residuals associated with the ingredients of EOS, and any byproducts produced as a result of chemical or biochemical reactions involving those ingredients. The following chapters of the Florida Administrative Code are cited: Chapter 62-550, F.A.C., for primary and secondary water quality standards; Chapter 62-520, F.A.C. for groundwater classes and standards, and minimum criteria; Chapter 62-522, F.A.C., for groundwater permitting and monitoring requirements; Chapter 62-528, F.A.C., for underground injection control, particularly Part V, for Class V, Group 4 aquifer remediation projects; and Chapter 62-777, F.A.C., for cleanup criteria.

A noteworthy aspect of the minimum criteria set forth in Chapter 62-520, F.A.C., is that it requires groundwater to be free from substances which are harmful to plants, animals, and organisms, and free from substances that are carcinogenic, mutagenic, teratogenic or toxic to human beings. In effect, these "free from" requirements form a catchall. They close what would otherwise be a loophole in the regulations by preventing injection of a potentially harmful product in the event that any of its ingredients is not regulated as a specific primary or secondary drinking water contaminant, or by Chapter 62-777, F.A.C.

- b. Injection well permit: The issuance of a site-specific Remedial Action Plan Approval Order by the Florida Department of Environmental Protection, for remediation via injection of EOS into an aquifer, constitutes the granting of the state's permit for a Class V injection well.
- c. EOS ingredients: The Department will discuss the ingredients of EOS, a proprietary product, only to the extent necessary for users to comply with regulations. EOS contains soybean oil, polysorbate 80, glycerol monooleate, yeast extract, and sodium lactate in proprietary proportions. Those proportions were confidentially disclosed to the Department in August 2002, and the Department is safeguarding that disclosure in accordance with Florida Statutes that recognize the need to protect trade secrets. Update: Per telephone discussion on May 17, 2005, the Raleigh, North Carolina supplier of EOS indicated that it no longer uses lecithin as an ingredient, and that sodium bromide tracer is not one of the manufacturer's ingredients but rather added independently, later, by some but not all users.
- d. Glycerol monooleate: There is no minimum groundwater criterion for the glycerol monooleate component of EOS. In accordance with FDA regulations (21 CFR 184.1323) it can be used in food with no limitation, and is classified by the FDA as GRAS (Generally Regarded as Safe). For these reasons, the Department believes that glycerol monooleate does not have to be an ingredient of concern when EOS is used.
- e. Zone of discharge by Rule 62-522.300(2)(c), F.A.C.: In order for EOS to be used for in situ, injection-type aquifer remediation, it is necessary to first obtain permission for a temporary injection zone of discharge for the following EOS components: soybean oil's total recoverable petroleum hydrocarbons (TRPH); polysorbate 80 surfactant; sodium (depending on the

amount of sodium lactate used); total dissolved solids; and chloride (a contaminant degradation byproduct). If a user decides to independently augment EOS with sodium bromide tracer, then bromide should be included. The zone of discharge for all six (6) of these parameters is obtained by way of Rule 62-522.300(2)(c), F.A.C.

The indication above that a zone of discharge is permitted by rule for all six parameters (five if the user does not add a tracer) is a correction to the previous April 7, 2003 EOS acceptance letter, which erroneously indicated that a zone of discharge for TRPH and polysorbate 80 could only be obtained by way of a variance.

Explanation. The Department's Underground Injection Control Program indicated in correspondence to EOS on April 7, 2005, in regard to variance petition case number OGC 05-0356, that the soybean oil and polysorbate 80 components of EOS are prime constituents of the reagents needed to remediate site contaminants. Since Rule 62-522.300(2)(c), F.A.C., permits a zone of discharge for such constituents, there is no need to permit the zone by variance.

- f. Meeting the requirements of Rule 62-522.300(3)(c), F.A.C.: In order to comply with Rule 62-522.300(2)(c), F.A.C., a Department-approved Remedial Action Plan proposing the use of EOS must: **(a)** identify the chemical species and parameters in the fluid to be injected that do not meet their groundwater standards [TRPH, polysorbate 80, sodium (depending on the amount of sodium lactate used), total dissolved solids, chloride (if significant amounts of this degradation byproduct will be generated), and bromide (if a bromine-containing tracer is used)]; **(b)** indicate the size and duration of a temporary zone of discharge that is needed for these parameters; and **(c)** address groundwater monitoring of these parameters before and after injection.

For the duration (period of time) that a temporary zone of discharge is permitted for EOS parameters, a temporary departure from the groundwater standards established for those parameters by Chapters 62-520 and 62-777, F.A.C., will be tolerated. By the end of the period, the groundwater must once again meet the established standards for each of these parameters, or their natural-occurring background value, whichever is less stringent.

The current maximum allowable groundwater concentrations for these parameters are as follows: TRPH, 5 milligrams per liter (mg/L); polysorbate 80, 35 mg/L; total dissolved solids, 500 mg/L; sodium, 160 mg/L; and chloride, 250 mg/L. For bromide, if a tracer is used, the standard shall be 0.05 mg/L or less, which is the concentration of bromide in "source water" for drinking water systems, per 40 CFR (Code of Federal Regulations), Part 141, National Primary Drinking Water Regulations that qualify systems for reduced bromide monitoring. Although the monitoring for bromide per National Primary Drinking Water Regulations arises mainly as a concern for bromate ( $\text{BrO}_3^-$ ) when ozone is used for disinfection, the Department reasons that the 0.05 mg/L concentration should be a suitable target level for remediation sites as well.

- g. Polysorbate 80: This is a nonionic surfactant of chemical composition  $\text{C}_{64}\text{H}_{124}\text{O}_{26}$ , Chemical Abstracts Service #9005-65-6. The Food and Drug Administration lists it as a food additive. The University of Florida's Center for Environmental and Human Toxicology, in correspondence dated September 24, 2001, indicated that a Department-calculated, maximum allowable groundwater concentration of 35 mg/L was reasonable.

For foaming agents (a group that includes surfactants) Chapter 62-550, F.A.C., indicates that Standard Method SM 5540 can be used for the analysis of drinking water samples. The Department, having reviewed SM 5540, believes it may be a viable method for the analysis of polysorbate 80 in groundwater samples from remediation sites as well. Method SM 5540-D applies to nonionic surfactants (and polysorbate 80 is a nonionic surfactant).

- h. Utilization of wells: If a remediation site happens to have an abundance of monitoring wells, then the Department has no objection to the use of some wells for the application of EOS. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used to apply EOS. This will avoid premature conclusions that the entire site meets cleanup goals. By making sure that designated tracking wells are not also used for treatment, there will be more assurance that the treatment process has permeated the entire site and that it did not remain localized to the area immediately surrounding each injection well.
- i. Additional nutrients: If, in the future, either the manufacturer or a user decides to augment EOS with other nutrients and/or chemicals, the injection of such nutrients and other chemicals into an aquifer must also be in accordance with the underground injection control requirements of Chapter 62-528, F.A.C., which requires that injected substances meet the drinking water standards set forth Chapter 62-550, F.A.C., and the minimum groundwater criteria of Chapter 62-520, F.A.C., which is now augmented by minimum groundwater criteria for specific chemicals listed in Chapter 62-777, F.A.C. If EOS is supplemented with commercially available microorganisms, then those microorganisms shall be non-pathogenic.
- j. Underground injection control inventory: Remedial Action Plans proposing injection-type, in situ aquifer remediation shall include information pursuant to Rule 62-528.630(2)(c)1 through 6, F.A.C., for the inventory purposes of underground injection control. Per Rule 62-528.630(2)(c), F.A.C., aquifer remediation projects involving injection wells may be authorized under the provisions of a Remedial Action Plan, provided the construction, operation, and monitoring requirements of Chapter 62-528, F.A.C., are met. A memorandum outlining the inventory information about injection-type aquifer remediation plans to be transmitted by Department reviewers, to the Underground Injection Control Section, is provided as Enclosure 3. Only the Department, including its district offices, may approve injection-type, in situ aquifer remediation plans for which the approval constitutes a Class V injection permit; local programs are not authorized to grant such approvals.
- k. Operation:
  - 1. Avoidance of migration: For in situ injection-type aquifer remediation projects, injection of EOS shall be performed in such a way, and at such a rate and volume, that no undesirable migration of either the product's ingredients or the contaminants already in the aquifer results, pursuant to Rule 62-528.630(3), F.A.C.
  - 2. Underground injection control operating permit: Although an operating permit is not required for aquifer remediation wells pursuant to Rule 62-528.640(1)(b), and 62-528.640(1)(c), F.A.C., since no movement of the contamination plume is expected to accompany the EOS treatment process, the Department requests that the

information items listed in Rule 62-528.640(1)(b), F.A.C., be considered and included in Remedial Action Plan proposals as a matter of good and thorough design practice. Briefly summarized, they are: quality of water in the aquifer; quality of the injected fluid; existing and potential uses of the affected aquifer; and well construction details. Additionally, each Remedial Action Plan should clearly indicate the total volume of EOS that will be injected.

1. Abandonment of wells: Upon issuance of a Site Rehabilitation Completion Order, or a declaration of "No Further Action", injection wells shall be abandoned pursuant to Section 62-528.645, F.A.C. The Underground Injection Control Section of the Department shall be notified so that the injection wells can be removed from the inventory-tracking list.

ENCLOSURE 2

SUPPLEMENTAL INFORMATION

The information below, compiled from several sources, may be helpful to reviewers of Remedial Action Plans prescribing bioremediation.

- a. Department of Environmental Protection reviewers of injection-type, in situ aquifer remediation plans, regardless of whether in Tallahassee or district offices, must fill in the blanks on the Enclosure 3 memorandum, whose subject is "Proposed Injection Well(s) for In Situ Aquifer Remediation at a Remedial Action Site". The completed form must be submitted to the Underground Injection Control Section at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

Only the Department and its district offices may approve in situ injection-type remediation plans in which the approval constitutes the issuance of a Class V injection permit; local programs are not authorized to grant such approvals. Reason: Although an arrangement between the Environmental Protection Agency and the Department delegates underground injection control authority to the Department, it does not allow the Department to delegate that authority any further. This includes delegation to the Department's contracted remediation review agencies such as those operated by the counties and other local governments.

- b. Dosage and application rate: The theoretical dosage of soybean oil, the key component of EOS, is established by the electron demand of the contaminants to be dechlorinated. (EOS is 10-20 percent soybean oil.) An example is given for perchloroethylene (PCE). One(1) gram of soybean oil will support the biodegradation of 7.9 grams of PCE. The biodegradation of 1 gram of the oil provides approximately 0.38 electron equivalents. One mole of perchloroethylene requires 8 electron equivalents or 0.048 electron/g PCE. If all the electrons from the soybean oil were used for PCE dechlorination, then 1 gram of the oil would support the biodegradation of 7.9 grams of PCE. The same reasoning applies to other contaminants to be degraded. The Department, however, suggests that potential users of EOS consult the manufacturer about dosages for their site-specific conditions.

As for the application rate, a typical rate for EOS is in the range of 100 to 500 gallons per injection point. For rule-of-thumb purposes only, EOS applied to sand and gravel aquifers has had an observed radius of influence of at least 30 feet from the point of injection. The Department suggests that users take into account their own site-specific conditions to determine if the radius of influence for their cleanup project will be more or less than 30 feet.

- c. Degradation products: The long chain fatty acids in EOS are degraded to simpler compounds such as acetic acid, propionic acid, and butyric acid by anaerobic bacteria. These compounds are further degraded to release hydrogen and electrons that are used by dechlorinating bacteria to remove chlorides, resulting in the production of relatively innocuous products such as ethane and ethene.
- d. Cleanup time: Like any other product or process, the cleanup time for EOS depends on site-specific conditions. It has been indicated, however, that chlorinated solvent contaminants at one EOS site decreased to non-detect levels in 3 months, and that another had a 66% reduction 16 months.

**Memorandum****Florida Department of  
Environmental Protection**

TO: Richard Deuerling, Mail Station 3530  
Division of Water Facilities  
Underground Injection Control Section  
Florida Department of Environmental Protection  
2600 Blair Stone Road, Tallahassee, FL 32399-2400

FROM: \_\_\_\_\_ (Note 1.)  
\_\_\_\_\_  
\_\_\_\_\_

DATE: \_\_\_\_\_

SUBJ: **Proposed Injection Well(s) for In Situ Aquifer  
Remediation at a Remedial Action Site**

Pursuant to Rule 62-528.630(2)(c), F.A.C, inventory information is hereby provided regarding the proposed construction of temporary injection well(s) for the purpose of in situ aquifer remediation at a contaminated site.

Site name: \_\_\_\_\_  
Site address: \_\_\_\_\_  
City/County: \_\_\_\_\_  
Latitude/Longitude: \_\_\_\_\_  
FDEP Facility Number: \_\_\_\_\_

Site owner's name: \_\_\_\_\_  
Site owner's address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Well contractor's name: \_\_\_\_\_ (Note 2.)  
Well contractor's address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Brief description of the in situ injection-type aquifer remediation project:

\_\_\_\_\_  
\_\_\_\_\_

Summary of major design considerations and features of the project:

Areal extent of contamination (square feet): \_\_\_\_\_  
Number of injection wells: \_\_\_\_\_  
Composition of injected fluid (Note 3)  
(ingredient, wt. %): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Injection volume per well (gallons): \_\_\_\_\_  
Single or multiple injection events: \_\_\_\_\_  
Injection volume total (all wells, all  
events): \_\_\_\_\_

Richard Deuerling  
Page Two  
Date: \_\_\_\_\_

Site name: \_\_\_\_\_  
FDEP facility no.: \_\_\_\_\_

A site map showing the areal extent of the groundwater contamination plume, and the location and spacing of injection wells and associated monitoring wells is attached.

The following is a summary description of the affected aquifer:

Name of aquifer: \_\_\_\_\_  
Depth to groundwater (feet): \_\_\_\_\_  
Aquifer thickness (feet): \_\_\_\_\_

The injection well(s) features are summarized below, and/or a schematic of the injection well(s) is attached.

Direct-push or Conventional (*circle the appropriate well type*)  
Diameter of well(s) (i.e., riser pipe & screen)(inches): \_\_\_\_\_  
Total depth of well(s) (feet): \_\_\_\_\_  
Screened interval: \_\_\_\_\_ to \_\_\_\_\_ feet below surface  
Grouted interval: \_\_\_\_\_ to \_\_\_\_\_ feet below surface  
Casing diameter, if applicable (inches): \_\_\_\_\_  
Cased depth, if applic.: \_\_\_\_\_ to \_\_\_\_\_ feet below surface  
Casing material, if applic.: \_\_\_\_\_

The in situ injection-type aquifer remediation plan for this contaminated site is intended to meet the groundwater cleanup criteria set forth in Chapter 62-777, F.A.C. Additionally, all other groundwater standards will be met at the time of project completion for any residuals associated with the ingredients of the injected remediation products, and any byproducts or intermediates produced as a result of the chemical or biochemical transformation of those ingredients or the contaminants during their use. Applicable primary and secondary drinking water standards are set forth in Chapter 62-550, F.A.C., and additional groundwater quality criteria are set forth in Chapter 62-520, F.A.C.

The remediation plan estimates that site remediation will take \_\_\_\_\_ months. We will notify you if there are any modifications to the remediation strategy, which will affect the injection well design or the chemical composition and volume of the injected remediation product(s).

The proposed remediation plan was approved on \_\_\_\_\_ by an enforceable approval order. A copy is attached. The remediation system installation is expected to commence within 60 days. Please call me at \_\_\_\_\_ if you require additional information.

Note 1. Local programs are not authorized to approve underground injections into aquifers. Reason: Per agreement with EPA, the FDEP cannot delegate this authority. Local programs, after reviewing a Remedial Action Plan or an injection proposal document, should arrange for Department headquarters' execution of an approval order, and then complete this form. This form is primarily for use by state and local program technical reviewers, but remediation contractors may fill in all blanks except those labeled "FROM", "DATE", and "approval date", and "telephone number" blanks in the last paragraph. Only a state or local program reviewer should complete those blanks.

Note 2. If an injection well installation contractor has not yet been selected, then indicate the name and address of the project's general remediation contractor/consultant.

Note 3. Complete chemical analysis of injected fluid is required by Chapter 62-528, Florida Administrative Code. Proprietary formulations shall make confidential disclosure. Injected fluids must meet drinking water standards of Chapter 62-550, F.A.C., unless an exemption or variance has been granted.